PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-176820
(43)Date of publication of application : 02.07.1999

(51)Int.Cl. H01L 21/31
H01L 21/205
H01L 21/314

(21)Application number : 10-125545
(22)Date of filing : 08.05.1998

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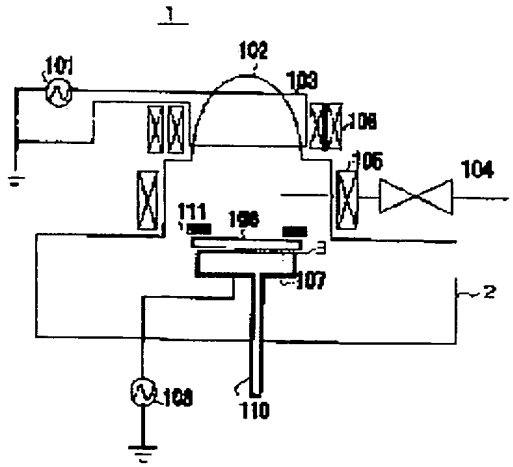
(30)Priority
Priority number : 09275435 Priority date : 08.10.1997 Priority country : JP

(54) FILM FORMATION TREATING EQUIPMENT OF SEMICONDUCTOR DEVICE, MANUFACTURE OF THE SEMICONDUCTOR DEVICE AND THIN-FILM FORMING METHOD OF SEMICONDUCTOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide film formation treating equipment of a semiconductor device which is capable of preventing exfoliation of a silicon oxide film in the peripheral part of a silicon substrate, in a vapor deposition method, where a carbon based film and an insulating film such as a silicon oxide film and a nitride film are laminated and formed.
SOLUTION: In a chamber 2 of a film formation treating equipment 1, a holder part 107 for holding a substrate 106 to be treated, a ring-shaped member 111 which chucks the substrate 106 to be treated between the ring-shaped member 111 and the holder part 107, and a reaction gas supply means 104 for supplying a specified reaction gas are installed. The ring-shaped member 111 has dimensions such that the inner diameter is smaller than the outer diameter of the holder part 107, and the outer diameter is larger than that of the holder part 107 and is constituted so as to concentrically cover the peripheral part of the surface of the substrate 106 to be treated, which is mounted on the holder part 107, while film forming treatment by reaction gas is conducted.



LEGAL STATUS
[Date of request for examination] 08.05.1998
[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3116904
[Date of registration]	06.10.2000
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	06.10.2003

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平11－176820

(43)公開日　平成11年(1999)７月２日

(51)Int.Cl.[6]	識別記号	ＦＩ	
Ｈ０１Ｌ 21/31		Ｈ０１Ｌ 21/31	Ｃ
21/205		21/205	
21/314		21/314	Ａ

審査請求　有　請求項の数18　ＯＬ　（全 13 頁）

(21)出願番号　特願平10－125545

(22)出願日　平成10年(1998)５月８日

(31)優先権主張番号　特願平9－275435

(32)優先日　平９(1997)10月８日

(33)優先権主張国　日本（ＪＰ）

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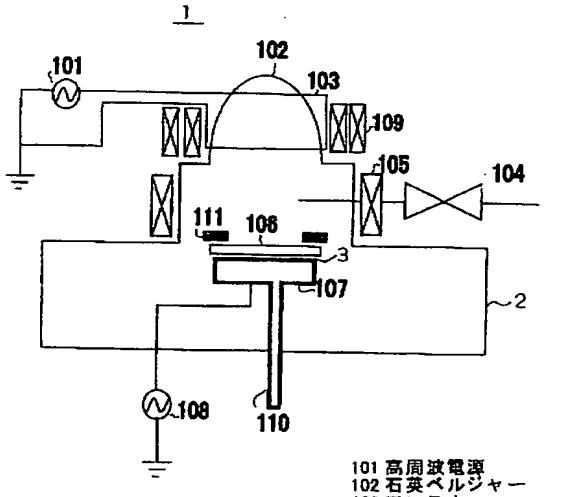
(54)【発明の名称】　半導体装置の成膜処理装置、半導体装置の製造方法及び半導体の薄膜形成方法

(57)【要約】

【課題】　炭素系膜および、シリコン酸化膜、窒化膜等の絶縁性膜を積層して形成する気相成長方法において、シリコン基板周辺部のシリコン酸化膜剥がれを防止する事が可能である半導体装置の成膜処理装置を提供する。

【解決手段】　成膜処理装置１のチャンバー２内には、被処理基板１０６を保持するホルダー部１０７、被処理基板１０６を当該ホルダー部１０７との間でチャックするリング状部材１１１、及び所定の反応ガスを供給する為の反応ガス供給手段１０４とが設けられており、リング状部材１１１は、その内径がホルダー部１０７の外径よりも小さく、且つその外径が当該ホルダー部１０７の外径よりも大きくなる様なディメンジョンを有し、当該リング状部材１１１は、反応ガスによる成膜処理が実行されている間、被処理基板１０７に搭載された被処理基板１０６の表面周縁部を同心円状に被覆する様に構成されている成膜処理装置１。



101 高周波電源
102 石英ベルジャー
103 アンテナ
104 原料ガス
105 永久磁石
106 試料
107 試料ホルダー
108 バイアス高周波電源
109 電磁石
110 水冷用冷却媒体
111 リング状部材

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] It is the membrane formation processor which is used in the production process of a semi-conductor and which contains the chamber for forming a carbon system interlayer film etc. in a processed substrate. In the chamber concerned of the membrane formation processor concerned Counter with the field of the side which carries the processed substrate concerned of the electrode-holder section holding the processed substrate concerned, and the electrode-holder section concerned at least, and it is prepared. The ring-like member which carries out the chuck of the processed substrate concerned between the electrode-holder sections concerned, The reactant gas supply means for supplying predetermined reactant gas in the chamber concerned is established. And the ring-like member concerned It has a dimension to which the bore becomes [the outer diameter] larger than the outer diameter of the electrode-holder section concerned smaller than the outer diameter of the electrode-holder section concerned. The ring-like member concerned The membrane formation processor characterized by being constituted so that the surface periphery section of the processed substrate carried in the processed substrate ~ concerned may be covered to concentric circular, while membrane formation processing by this reactant gas is performed.
[Claim 2] The membrane formation processor according to claim 1 characterized by the electrode-holder section concerned being what consists of electrostatic chucks.
[Claim 3] The ring-like member concerned is a membrane formation processor according to claim 1 or 2 characterized by forming the taper section in the part.
[Claim 4] The membrane formation processing concerned is a membrane formation processor given in claim 1 thru/or any of 3 they are. [which is characterized by being CVD]
[Claim 5] The carbon system interlayer film concerned is a membrane formation processor given in claim 1 thru/or any of 4 they are. [which is characterized by being a fluorine content carbon system interlayer film]
[Claim 6] The fluorine content carbon system interlayer film concerned is a membrane formation processor according to claim 5 characterized by being an amorphous carbon fluoride system interlayer film.
[Claim 7] The membrane formation processing concerned is a membrane formation processor given in claim 1 thru/or any of 6 they are. [which is characterized by being the processing which forms at least the insulator layer by which a laminating is carried out to the carbon system interlayer film concerned and the carbon system interlayer film concerned on a substrate]
[Claim 8] The ring-like member concerned is a membrane formation processor given in claim 1 thru/or any of 7 they are. [which is characterized by the thing movable in a direction vertical to the front face of the electrode-holder section concerned when a cleaning process is performed at least constituted like]

[Claim 9] It is the membrane formation processor which is used in the production process of a semi-conductor and which contains the chamber for forming a carbon system interlayer film etc. in a processed substrate. In the chamber concerned of the membrane formation processor concerned The reactant gas supply means for supplying the electrode-holder section holding the processed substrate concerned and predetermined reactant gas in the chamber concerned at least is established. The electrode-holder section concerned is a membrane formation processor characterized by consisting of electrostatic chucks, and connecting with the periphery edge of the electrostatic chuck concerned, and preparing still more nearly another electrode.
[Claim 10] The membrane formation processor according to claim 9 characterized by impressing bias voltage to the another electrode concerned.
[Claim 11] In order to form an insulator layer etc. in the processed substrate used in the production process of a semi-conductor, It is multi chamber equipment with which at least two chambers including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding the processed substrate concerned to the interior are prepared. The 1st chamber concerned is what is used for membrane formation of a carbon system interlayer film. The chamber of **** 2 The manufacturing installation of the semi-conductor which is used for membrane formation of silicon oxide or a silicon nitride, and is characterized by the plasma consistency of the 2nd chamber concerned being lower than the plasma consistency of the 1st chamber concerned.
[Claim 12] The manufacturing installation of the semi-conductor according to claim 11 characterized by using the source of the high density plasma for the 1st chamber concerned, and using the source of the parallel plate mold plasma for the 2nd chamber concerned at least.
[Claim 13] In order to form an insulator layer etc. in the processed substrate used in the production process of a semi-conductor, It is multi chamber equipment with which at least two chambers including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding the processed substrate concerned to the interior are prepared. The 1st chamber concerned is what is used for membrane formation of a carbon system interlayer film. The chamber of **** 2 The manufacturing installation of the semi-conductor characterized by using the source of the parallel plate mold plasma also for the 2nd chamber concerned while being used for membrane formation of silicon oxide or a silicon nitride and using the source of the parallel plate mold plasma for the 1st chamber concerned.
[Claim 14] A chamber including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding a processed substrate to the interior is used. The manufacture approach of the semi-conductor characterized by performing membrane formation processing as it faces supplying reactant gas to this processed substrate to the processed substrate concerned in the approach of forming a carbon system interlayer film etc. at least, and forming a carbon system interlayer film etc. and the carbon system film concerned does not form membranes at the periphery edge of the processed substrate concerned.
[Claim 15] The ring-like member which contacts the periphery edge of the processed substrate concerned currently held at the electrode-holder section concerned is prepared. It is made to function so that the ring-like member concerned may carry out the chuck of this processed substrate carried in the electrode-holder section concerned. The manufacture approach of the semi-conductor according to claim 14 characterized by covering the surface periphery section of the processed substrate concerned to concentric circular while membrane formation processing by this reactant gas is performed to the processed substrate concerned in the ring-like

member concerned.
[Claim 16] The manufacture approach of the semi-conductor according to claim 14 characterized by connecting with the periphery edge of the electrostatic chuck concerned while constituting the electrode-holder section concerned holding the processed substrate concerned from an electrostatic chuck, preparing still more nearly another electrode, and impressing bias voltage to the another electrode concerned.
[Claim 17] The thin film formation approach of a semi-conductor that the field on which a processed silicon substrate is made to deposit a carbon system insulator layer is characterized by being smaller than the field on which silicon oxide or a silicon nitride is made to deposit in the thin film formation approach for forming the semiconductor device which has a carbon system interlayer film, silicon oxide, or a silicon nitride at least as an interlayer insulation film.
[Claim 18] The thin film formation approach of the semi-conductor characterized by the plasma consistency of the source of the plasma for depositing silicon oxide or a silicon nitride on a processed silicon substrate forming membranes using a thing lower than the source of the plasma which deposits a carbon system interlayer film in the thin film formation approach for forming the semiconductor device which has a carbon system interlayer film, silicon oxide, or a silicon nitride at least as an interlayer insulation film.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the manufacture approach of the membrane formation processor in silicon oxide or a silicon nitride, and the production process of the semi-conductor which performs coat formation which uses carbon as a principal component, and a semiconductor device etc. in detail especially about the membrane formation processor in the production process of a semi-conductor.
[0002]
[Description of the Prior Art] In recent years, wiring which connects between individual components is more complicated with high integration of the semi-conductor ultra-large scale integrated circuit LSI. If wiring is bypassed in order to avoid the crossover of wiring, the monopoly area of wiring occupied to a chip area will increase. Since it becomes still longer [a wire length], wiring delay also poses a problem.
[0003] Then, wiring is multilayered by inserting an insulator layer between wiring, and the technical multilayer-interconnection technique which prevents the crossover part and lap of wiring is general. With the starting multilayer-interconnection technique, reduction of the capacity between wiring of the same layer and the capacity between wiring between vertical wiring layers is indispensable. That is, when it becomes the cause of wiring delay or the signal containing a high frequency component is transmitted in both two wiring that adjoined by the upper and lower sides on both sides of the interlayer insulation film, a cross talk arises, and buildup of the capacity between wiring causes malfunction.
[0004] Si3N4 which is the insulator layer widely used by LSI technology from the above technological background Specific inductive capacity: epsilonr-7 and SiO2 Specific inductive capacity: Using the small film of specific-inductive-capacity epsilonr replaced with epsilonr-3.9 etc. as a layer insulation nature thin film is examined, and the amorphous fluoridation carbon film attracts attention as one of them. For example, in the Japanese-Patent-Application-No. No. 321694 [08 to] official report, the amorphous fluoridation carbon film is used as a low dielectric constant ingredient.
[0005] From the usual through hole opening using a resist not being made since the carbon film concerned is easily etched by the oxygen plasma Even if there are few amorphous fluoridation carbon films at the multiple address, silicon oxide or a nitride is formed on the top face. "Silicon oxide / carbon film / silicon oxide" Or it considers as a silicon nitride / carbon film / "silicon nitride" laminated structure, and the silicon oxide on the top face of a carbon film and a nitride are used also as a flattening insulator layer by chemical machinery polish (CMP) while they are covering film to the oxygen plasma.
[0006] Here explains the outline of the manufacture approach of the semiconductor

device using a carbon film using drawing 8 . A carbon film 802 is made to deposit between the wiring metals 801 first. C four F8 etc. -- carbon fluoride gas is used as a raw material, and it is made to deposit with plasma chemistry vapor growth (CVD) At this time, an amorphous fluoridation carbon film can be embedded between detailed wiring by impressing about dozens of W bias power to a substrate.

[0007] Moreover, the adhesion force can be raised by making the silicon oxide which made the presentation superfluous [silicon] deposit on the substrate silicon substrate 803 or the wiring metal 801, and 802 between carbon films. Then, silicon oxide 804 is made to deposit by the same plasma CVD on a carbon film 802. Also at this time, the adhesion force can be raised by making silicon oxide with superfluous silicon deposit to a carbon film / silicon oxide interface.

[0008] Then, CMP is performed on silicon oxide 804 and flattening of the wiring upper part is carried out. A multilayer interconnection is made to form by making the well-known plug metals 805, such as aluminum, deposit on the beer hall 807 which etched and carried out opening of silicon oxide and the carbon film using the still better known RISOGURAFU technique, and making the metal 806 of the 2nd layer deposit. Of course, it cannot be overemphasized by repeating these processes that wiring more than two-layer can be formed.

[0009] Here, an example of the configuration of the membrane formation equipment of a common amorphous fluoridation carbon film or silicon oxide is shown in drawing 6 . A silicon wafer 606 (the case where surface [at least / a part of] has a certain different ingredient from silicon hereafter will be called a silicon wafer, and it distinguishes from a silicon substrate) is arranged on the sample electrode holder 607 which serves as a lower electrode in this equipment. By this example, the electrostatic chuck is used as a sample electrode holder 607.

[0010] A substrate can be cooled by raising thermal conductivity and missing the heat of a substrate to the sample electrode-holder 607 side by generally spraying gaseous helium on silicon wafer 606 rear face from the sample electrode holder 607 carried out water-cooled 610. It has the structure where the power source 608 for high frequency bias can be impressed to the sample electrode holder 607 independently of the source of the plasma.

[0011] By impressing high frequency to this sample electrode holder 607, negative bias can be effectually impressed to a silicon wafer 606, and ion energy by negative bias can be controlled, for example, it is used for an improvement of an embedding property. In the conventional equipment shown in drawing 6 , a helicon wave generates the plasma, and lead to the antenna 603 on which high frequency was stuck by the periphery of the quartz chamber 602 from RF generator 601 for plasma, and the magnetic field of the permanent magnet 605 too installed in the quartz chamber 602 exterior and an electromagnet 609 is made to act, and it is efficient and carries out plasma generating in the quartz chamber 602 interior.

[0012] Of course, the discharge format for a carbon film or silicon oxide membrane formation is not necessarily limited to a helicon wave method, and discharge formats, such as a electron cyclotron resonance type, an inductive-coupling type, and a capacity-coupling type, are used for membrane formation to current. In addition, in order to lessen the peeling omission of the coats adhering to the member near a processed substrate about the membrane formation technique of a semiconductor device as indicated by JP,4-368119,A, for example, the approach of carrying out surface roughening of the front face of the member near a processed substrate is shown, but reference is not made if attached to the problem by the pyrolysis of an amorphous fluoridation carbon film.

[0013] Moreover, although the manufacture approach of the semiconductor device which forms the film of a tungsten by CVD is indicated by JP,6-208959,A, there is no

reference about the technique which uses an amorphous fluoridation carbon film.
[0014]
[Problem(s) to be Solved by the Invention] In the former, generally, in CVD manufacturing installations, such as a carbon system thin film, silicon oxide, and a nitride, when an electrostatic chuck type electrode holder was used for the sample electrode holder 607, the diameter had the constraint to which it is smaller than the diameter of a silicon wafer 606 in any case, and must carry out.
[0015] Because, when the electrostatic chuck type sample electrode holder 607 with a bigger diameter than the diameter of a silicon wafer 606 was used, membrane formation processing was repeated many times, the coat accumulated in the member concerned along with it became thick, and it had the problem to which immobilization of a silicon wafer 606 not only becomes difficult, but substrate cooling effectiveness falls. It had the problem on which sample electrode-holder 607 skin temperature of the field where the electrostatic chuck type sample electrode holder 607 is furthermore exposed to the high density plasma rises and deteriorates.
[0016] On the other hand, when the diameter of the electrostatic chuck type sample electrode holder 607 is smaller than the diameter of a silicon substrate, since it does not have the field where the sample electrode holder 607 is exposed to the high density plasma, the problem on which sample electrode-holder 607 skin temperature rises and deteriorates can be avoided. However, since, only as for the periphery of a silicon wafer 606, the sample electrode holder 607 was not able to contact, the wafer outermost periphery had the problem to which cooling effectiveness falls.
[0017] When creating the laminated structure which consists of combination which is called silicon oxide / carbon film / silicon oxide, or a silicon nitride / carbon film / silicon nitride using such a sample electrode holder, a carbon film is formed making a silicon nitride or an oxide film deposit, and usually using substrate temperature as about 100 degrees C after that first. Since the substrate bias which in the case of a carbon film is used in order to raise an embedding property is less than [50W], the periphery temperature which does not receive cooling is suppressed by lifting of about 120 degrees C, and the film is deposited all over a wafer.
[0018] Next, a silicon nitride or an oxide film is made to deposit further on a carbon film. If use the high density plasma, about 1kW bias power is moreover impressed, substrate temperature is raised at about 300 degrees C and membranes are formed in order to raise an embedding property in order to make the good film deposit at this time and, the periphery of a silicon wafer 606 will go up rather than about 400 degrees C of the heat-resistant temperature of an amorphous fluoridation carbon film.
[0019] Consequently, the amorphous fluoridation carbon film decomposed and it had the problem that silicon oxide separated by the gas which occurs as a result. In the vapor growth approach which the object of this invention improves the fault of the above-mentioned conventional technique, and carries out the laminating of the insulating film, such as carbon system film and silicon oxide, and a nitride, and forms it It is what offers the manufacturing installation of the semiconductor device which can prevent silicon oxide peeling of a silicon substrate periphery. Further The peeling omission of the coat [**** / un-] which adheres near a processed substrate periphery is lessened, and it aims at offering the membrane formation processor or the membrane formation approach of aiming at generating reduction of silicon oxide peeling.
[0020]
[Means for Solving the Problem] This invention adopts a fundamental technical configuration as shown below in order to attain the above-mentioned object. Namely, as the 1st mode concerning this invention, are used in the production process of a

semi-conductor. It is the membrane formation processor which contains the chamber for forming a carbon system interlayer film etc. in a processed substrate. In the chamber concerned of the membrane formation processor concerned Counter with the field of the side which carries the processed substrate concerned of the electrode-holder section holding the processed substrate concerned, and the electrode-holder section concerned at least, and it is prepared. The ring-like member which carries out the chuck of the processed substrate concerned between the electrode-holder sections concerned, The reactant gas supply means for supplying predetermined reactant gas in the chamber concerned is established. And the ring-like member concerned It has a dimension to which the bore becomes [the outer diameter] larger than the outer diameter of the electrode-holder section concerned smaller than the outer diameter of the electrode-holder section concerned. The ring-like member concerned It is the membrane formation processor constituted so that the surface periphery section of the processed substrate 106 carried in the processed substrate concerned may be covered to concentric circular, while membrane formation processing by this reactant gas is performed. It is the membrane formation processor which is used in the production process of a semi-conductor as a mode of **** 2 and which contains the chamber for forming a carbon system interlayer film etc. in a processed substrate. The electrode-holder section which holds the processed substrate concerned at least in the chamber concerned of the membrane formation processor concerned, And it is the membrane formation processor with which the reactant gas supply means for supplying predetermined reactant gas in the chamber concerned is established, and the electrode-holder section concerned consists of electrostatic chucks, and it connects with the periphery edge of the electrostatic chuck concerned, and still more nearly another electrode is prepared.

[0021] Furthermore, as the 3rd mode concerning this invention, are used in the production process of a semi-conductor. It is multi chamber equipment with which at least two chambers including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding the processed substrate concerned to the interior in order to form an insulator layer etc. in a processed substrate are prepared. The 1st chamber concerned is what is used for membrane formation of a carbon system interlayer film. The chamber of **** 2 It is what is used for membrane formation of silicon oxide or a silicon nitride, and is the manufacturing installation of the semi-conductor set up so that the plasma consistency of the 2nd chamber concerned might become lower than the plasma consistency of the 1st chamber concerned.

[0022]

[Embodiment of the Invention] That is, as technical thought [-like in common] in this invention, the membrane formation range is limited to the appearance by which it faces forming a carbon system interlayer film in a membrane formation processor using the source of the high density plasma, and is the part of the border of a substrate at least, and a carbon film is not formed by the part to which cooling is not performed without a substrate's touching a substrate electrode holder, and it is made to perform membrane formation processing actuation.

[0023] Thereby, even if wafer circumference part temperature rises at the time of the upper silicon oxide membrane formation, generating of a decomposition product can be controlled and periphery peeling can be prevented. Apart from the approach of arranging the ring-like member to cover, and the electrode-holder section which serves both as an electrode, the 2nd electrode is arranged at the periphery edge of the electrode-holder section concerned. it described above as an example for it -- like -- the periphery edge of the processed substrate concerned -- membrane formation -- in process -- in -- the approach by which a carbon film is made to be

formed by the periphery edge of the processed substrate concerned -- further In membrane formation of the silicon oxide to a carbon system interlayer film top, or a silicon nitride As the film concerned was made to deposit on the carbon system film using the manufacturing installation which consists of plasma production equipment with a low plasma consistency, when the carbon system film is formed to the outermost periphery, substrate outermost periphery temperature can prevent film peeling by reaching to the decomposition temperature of the carbon system film.
[0024] That is, in this invention, the boundary region of a silicon wafer is provided with an equipment configuration by which a carbon film is not formed, or its membrane formation approach in carbon system film membrane formation equipment. The member 111 of the shape of a ring made from a quartz is put only on a wafer periphery, and it is more specifically [in order / above-mentioned / to make it membranes not formed by the periphery of the processed substrate concerned in this invention like] a wrap about a wafer periphery. The outer diameter of a ring-like member is larger than the diameter of a sample electrode holder, and a bore is smaller than the diameter of a wafer and arranges these to a wafer and concentric circular. By adopting the starting configuration, a part of deposition film adheres to a ring-like member, and is not deposited on a wafer in the periphery section.
[0025] Moreover, as other examples, a ring-like electrode is prepared only in the wafer periphery section, and high-frequency power is supplied to a ring-like electrode. Consequently, the ion accelerated by high-frequency power is irradiated by the substrate, and a sputtering operation of the deposition film by ion arises only in the substrate periphery section. This sputtering rate and the membranous rate of sedimentation are equivalent, or when a sputtering rate is high, membranous deposition to a circumference part is no longer seen.
[0026] Or in the invention in this application, the manufacturing installation constituted so that the temperature at the time of the covering film membrane formation of silicon oxide etc. after carbon system film deposition might not exceed the thermal resistance of the carbon system film is used. The above-mentioned sputtering means which changes a sputtering consistency positively like is used selectively, and disassembly of the carbon system film does not take place by the approach of starting, but a coat piece seems for example, not to separate easily on a silicon wafer periphery.
[0027]
[Example] Below, the configuration of the example of the membrane formation art of the membrane formation processor of the semiconductor device concerning this invention and a semiconductor device is explained at a detail, referring to a drawing. Namely, drawing 1 is the side elevation showing the whole single-wafer-processing CVD system configuration by one example of this invention. It is the membrane formation processor 1 which is used in the production process of a semi-conductor among drawing and which contains the chamber 2 for forming a carbon system interlayer film etc. in the processed substrate 106. In the chamber 2 concerned of the membrane formation processor 1 concerned Counter with the field 3 of the side which carries the processed substrate 106 concerned of the electrode-holder section 107 holding the processed substrate 106 concerned, and the electrode-holder section 107 concerned at least, and it is prepared. The reactant gas supply means 104 for supplying the ring-like member 111 which carries out the chuck of the processed substrate 106 concerned between the electrode-holder sections 107 concerned, and predetermined reactant gas in the chamber 2 concerned is established. The bore of the ring-like member 111 concerned is smaller than the outer diameter of the electrode-holder section 107 concerned. It has a dimension to which the outer diameter becomes larger than the outer diameter of the electrode-

holder section 107 concerned. And the ring-like member 111 concerned While membrane formation processing by this reactant gas is performed, the membrane formation processor 1 constituted so that the surface periphery section of the processed substrate 106 carried in the processed substrate 107 concerned may be covered to concentric circular is shown.

[0028] Although especially the configuration of the electrode-holder section 107 concerned concerning this invention is not limited, it is desirable that it is what consists of electrostatic chucks for example. By using the starting electrostatic chuck, it becomes possible to arrange this ring-like member 111 to a position in the condition arranged on the electrode-holder section 107 concerned of not contacting the processed substrate 106 and directly unlike the ring chuck method in the above-mentioned JP,6-208959,A approach.

[0029] The membrane formation procedure in the above-mentioned example in this invention is explained below. That is, the silicon wafer 106 which is a processed substrate is introduced into the anteroom (not shown) which was intercepted by the preceding paragraph of a plasma production room with the gate valve (not shown), and was established in it, a silicon wafer 106 is introduced into the plasma production room which carried out vacuum suction of the anteroom, opened the gate valve, and was maintained by the high vacuum, and it installs on the sample electrode holder 107.

[0030] then -- if a gate valve is closed and the degree of vacuum of the plasma production interior of a room becomes a high vacuum again -- CF4, C two F6, and C four F8 etc. -- carbon fluoride gas or CH4, and C2H2 etc. -- hydrocarbon gas or those mixed gas is used as a raw material 104, and these material gas is introduced into the plasma production interior of a room. Here, an amorphous fluoridation carbon film is formed by impressing a RF or direct current power and making it discharge at the antenna 103 for previous plasma production.

[0031] On the other hand by membrane formation of silicon oxide, it is SiH4 as material gas 104. O2 It uses and is SiH4 at a silicon nitride. N2 Or NH3 Membranes are used and formed. In addition, the membrane formation equipment 1 of the semiconductor device used by this invention uses that for which it was called the multi-cluster, for example, two membrane formation rooms 501 and 502 like drawing 5 were prepared.

[0032] It is what is got blocked, for example, is called one membrane formation room chamber 501. An amorphous fluoridation carbon film Since the low dielectric constant interlayer insulation film which calls the another side chamber 502, enables it to form the flattening film, and consists of a silicon oxidation membrane layer and an amorphous fluoridation carbon film is constituted by the appearance by which continuation formation is carried out The membrane formation number of sheets per unit time amount is increased, and it is equipment which can form silicon oxide in the upper part of the amorphous fluoridation carbon film concerned, without carrying out atmospheric-air exposure after amorphous fluoridation carbon film membrane formation.

[0033] However, this invention is not necessarily limited only to a multi-cluster type, and also when an amorphous fluoridation carbon film, silicon oxide, and a silicon nitride are manufactured by the separate manufacturing installation, it can be applied. The configuration of this example is the example of the low dielectric constant interlayer film membrane formation equipment which consists of chambers 501 and 502 which have two sources of the high density plasma. By this example, if the configuration of the wafer presser-foot section in the membrane formation chamber 501 of an amorphous fluoridation carbon film is changed with the conventional approach and it is explained by other drawing 6 , it shall have the same configuration.

[0034] Here, it is attached to the configuration of the membrane formation processor in this example using drawing 2 , and explains to a detail. That is, although the 6 inch silicon wafer 106 is carried in the sample electrode holder 107 which is the substrate installation base of the processing interior of a room used for membrane formation of an amorphous fluoridation carbon film, by this example, the electrode-holder section concerned consists of electrostatic chucks, and carries out maintenance immobilization of the silicon wafer 106 using the sample electrode holder 107 of the electrostatic chuck concerned.
[0035] The diameter of an electrostatic chuck will be smaller than a wafer 106 10mm, and it will be desirable to set up, consequently cooling will be performed for the part from the periphery edge of a wafer 106 to 5mm inside. Next, the ring-like member 111 made from a quartz is formed, and the circumference of a silicon wafer 106 is covered. An outer diameter is larger than a 6 inch wafer diameter 100mm, namely, the ring-like member 111 concerned is jutted out out of 50mm rather than a wafer edge, and its bore is smaller than a wafer diameter 14mm.
[0036] That is, an inside part is covered with a ring-like member from the periphery section of a wafer to 7mm. Moreover, thickness of a member was set to 5mm. Although thickness of a member was set to 5mm for giving sufficient mechanical strength, of course, it is not limited to this thickness. By using the ring-like member 111 concerned in this example, an amorphous fluoridation carbon film can be formed on the silicon wafer 106 of a field smaller than the diameter of the sample electrode holder 107 of an electrostatic chuck.
[0037] Although the ring-like member 111 concerned may contact directly the silicon wafer 106 which is the processed substrate concerned, it is desirable to be preferably set as a position in a silicon wafer 106 and the non-contact condition. Moreover, although not limited especially concerning the cross-section configuration of the ring-like member concerned, as shown in drawing 3 , it is also desirable [the ring-like member 111 concerned] that the taper section which had the predetermined include angle, for example, the include angle of 45 degrees, for any of fields other than the field which counters, the part 106, for example, silicon wafer concerned, being is formed.
[0038] The starting taper section is [in / the cleaning process to state] effective in removing the carbon system matter adhering to the ring-like member 111 concerned. Moreover, as for the ring-like member 111 concerned used in this example, it is desirable to be set up in the vertical direction movable to the principal plane of the silicon wafer 106 concerned, and it is [in / especially / loading to the electrode-holder section 107 concerned of the silicon wafer 106 concerned, blowdown actuation, or a cleaning process] desirable to be constituted so that it can move in the direction which separates from the principal plane of the silicon wafer 106 concerned.
[0039] Then, when the gate valve was closed and the degree of vacuum of the plasma production interior of a room became 10 to 8 torrs or less again, material gas 104 was introduced into the plasma production interior of a room, and the degree of vacuum was usually adjusted to 0.01-0.05 torrs. An amorphous fluoridation carbon film is formed by impressing a 13.56MHz RF and making it discharge at the antenna 103 for previous plasma production here.
[0040] That for which two membrane formation rooms like drawing 1 were prepared is used, an amorphous fluoridation carbon film is formed by one membrane formation room chamber 501, and it enables it to form silicon oxide or a silicon nitride by the another side chamber 502 by this example, as shown in drawing 5 . Continuation formation of the low dielectric constant interlayer insulation film which consists of a

silicon oxidation membrane layer and an amorphous fluoridation carbon film by this is carried out. In the equipment which forms silicon oxide by the chamber 502, the sample electrode holder 107 of an electrostatic chuck is easy to be the same as that of the conventional thing.

[0041] In this example, since the amorphous fluoridation carbon film was not formed on the outskirts, even if the field which cannot perform cooling of a periphery became the elevated temperature of 400 degrees or more which is the thermal resistance of an amorphous fluoridation carbon film in silicon oxide membrane formation, since the amorphous fluoridation carbon film was not formed in this field, it became possible to prevent peeling of the film at the time of silicon oxide formation.

[0042] In addition, like the conventional approach which does not use a ring about the construction material of a ring-like member, in order not to change the condition of the plasma, the insulating material is used. Equivalent effectiveness was acquired in this invention, using a quartz and an alumina as the ring-like member 111 concerned. Moreover, about the bore of a ring-like member, it turned out that what is necessary is just smaller than the diameter of an electrostatic chuck at least.

[0043] In addition, although most decomposition products of reactant gas or resultants, for example, amorphous fluoridation carbon, are deposited on a silicon wafer 106, a part adheres to the inside wall of the member of the shape of a ring 111, especially the ring-like member 111 concerned. Membrane formation processing is repeated many times, and since the coat deposited on the member concerned along with it becomes thick and serves as dust at the time of the next membrane formation, it is necessary to clean this amorphous fluoridation carbon film.

[0044] Next, cleaning is explained. In an oxygen ambient atmosphere, a cleaning process exposes the ring-like member 111 to the plasma, and performs it. Consequently, the amorphous fluoridation carbon film deposited on the side-attachment-wall section of the ring-like member 111 concerned reacts with oxygen, and is etched. After the cleaning process concerned is completed, it moves to next membrane formation.

[0045] In this cleaning process, the carbon film adhering to the member 111 lower part is removable by exposing the member 111 of the shape of this ring to the plasma of an oxygen ambient atmosphere, and performing it from the sample electrode holder 107, after moving to the distance of about 3cm. The carbon film adhering to a ring-like member was thoroughly removable by cleaning the amorphous fluoridation carbon film of 5000A of thickness for 3 minutes after one wafer membrane formation as an example in the CVD process formed on a semi-conductor wafer by oxygen flow rate 200sccm, 3kW of plasma power, and pressure 2mTorr.

[0046] Moreover, it arose that particle appears from a ring-like member when not cleaning for every sheet, when 30 membrane formation, i.e., a 15-micron amorphous fluoridation carbon film, was made to deposit. That is, it is desirable to clean to less than 30 membrane formation in this case. The cleaning time amount from which the amorphous fluoridation carbon film adhering to a ring is removed thoroughly was 90 minutes.

[0047] Next, the example at the time of attaching a taper to the ring-like member 111 concerned is explained. As shown in drawing 3 , it considered as the thickness of 5mm with the outer diameter, and the taper was beforehand attached to the ring-like member 111 so that thickness might be set to 0 with a bore. In this case, the large cross section of the ring-like member 111 exposed to the oxygen plasma during cleaning can be taken, and since the area of the bore side face where a cleaning rate is slow can be lost, clearance is performed efficiently.

[0048] Therefore, when the CVD process which forms the amorphous fluoridation carbon film of 5000A of thickness on a semi-conductor wafer under the above

conditions was repeated about many semi-conductor wafers, by the member 111 of the shape of a ring without a taper, cleaning time amount took 3 minutes, but when a taper was attached, the amorphous fluoridation carbon film was removed in 2 minutes. Therefore, according to this example, processing number of sheets can be made to increase per unit time amount of equipment as compared with the conventional approach, because the cleaning time amount of the ring-like ring-like member 111 becomes short. In addition, about the outside side face, it was located out of 5cm rather than the wafer periphery, and the deposition of a carbon film to the part concerned was not seen with the CVD system used by this example.

[0049] That is, as for the membrane formation processing concerned in this invention, it is desirable that it is CVD, and, as for the carbon system interlayer film concerned, it is desirable that it is also a fluorine content carbon system interlayer film. Furthermore, as for the fluorine content carbon system interlayer film concerned, it is more desirable that it is an amorphous carbon fluoride system interlayer film. Also as for **, in this invention, it is [the membrane formation processing concerned] desirable that it is the processing in which the insulator layer by which a laminating is carried out at least to the carbon system interlayer film concerned and the carbon system interlayer film concerned on a substrate is formed.

[0050] Moreover, when a cleaning process is performed at least, the thing movable in a direction vertical to the front face of the electrode-holder section concerned of the above-mentioned ring-like member concerned used in this invention like constituted like is desirable. Next, it attaches and explains to the configuration of other examples in this invention. That is, the starting example is a membrane formation processor which is used in the production process of a semi-conductor and which contains the chamber for forming a carbon system interlayer film etc. in a processed substrate. The electrode-holder section which holds the processed substrate concerned at least in the chamber concerned of the membrane formation processor concerned, And it is the membrane formation processor 1 characterized by establishing the reactant gas supply means for supplying predetermined reactant gas in the chamber concerned, and for the electrode-holder section concerned consisting of electrostatic chucks, and connecting with the periphery edge of the electrostatic chuck concerned, and preparing still more nearly another electrode.

[0051] The configuration of the above-mentioned example concerning this invention is explained referring to drawing 4 . That is, by this example, since there is no ring-like member 111 in wafer 406 front face, the process of cleaning has the description it is easy featureless. The sample 406 of the processing interior of a room used for membrane formation of a carbon system interlayer film is installed using the same lower electrode 403 as the above mentioned example, and the electrostatic chuck 401.

[0052] Next, the 2nd electrode 402 made from SUS is formed in the outside of the electrostatic chuck 401, and impression of a RF is attained independently [the lower electrode 401]. The 2nd electrode 402 concerned touches the periphery of the electrostatic chuck 401 which makes a lower electrode serve a double purpose, and the periphery of an electrode came out of it out of 5mm from the wafer edge. Material gas is introduced [then,] in the plasma production interior of a room, and a degree of vacuum is usually adjusted to 0.01-0.05 torrs.

[0053] An amorphous fluoridation carbon film is formed by impressing a 13.56MHz RF and making it discharge at the antenna for plasma production here. An electrode part is made to generate negative bias voltage by using a 400kHz power source at the time of amorphous fluoridation carbon film membrane formation, and impressing power to an electrode 402 at it. Consequently, sputtering of the part where a processed substrate periphery edge is not cooled is selectively carried out with the

cation locally accelerated by the bias generated in the 2nd electrode 402.
[0054] Here, the membrane formation rate and sputtering rate of a carbon film are equivalent, or when a sputtering rate is high, membrane formation does not take place in the periphery section, but effectiveness equivalent to a ring-like member can be acquired. By this example, membrane formation of an amorphous fluoridation carbon film of a 6mm part was able to be prevented from wafer 401 edge by impressing the power of 500W to an electrode 402.
[0055] Thereby, film peeling at the time of subsequent silicon oxide formation was able to be prevented. Moreover, membranous deposition was not looked at by the electrode made from after [wafer membrane formation] SUS, and, especially as for degradation of an electrode etc., after 1000 wafers processing was not accepted. That is, in the example of the diode 2 in this invention, an electrode is prepared independently [the electrode-holder section 401 which serves as the polar zone which consists of electrostatic chucks], and bias voltage is made to be impressed to the another electrode concerned.
[0056] Next, the configuration of other examples concerning this invention is explained to a detail with reference to drawing 5 R> 5 and drawing 7 . Drawing 5 shows the configuration of one example of a multi chamber system in which each vacuum housings for processing of all by which the modularization was carried out are reaction containers for CVD processing, as described above.
[0057] Namely, in this example, are used in the production process of a semi-conductor. It is multi chamber equipment with which at least two chambers including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding the processed substrate concerned to the interior in order to form an insulator layer etc. in a processed substrate are prepared. The 1st chamber concerned is what is used for membrane formation of a carbon system interlayer film. The chamber of **** 2 It is what is used for membrane formation of silicon oxide or a silicon nitride. And if it is the manufacturing installation of the semi-conductor with which the plasma consistency of the 2nd chamber concerned is characterized by being lower than the plasma consistency of the 1st chamber concerned, for example, the source of the high density plasma is used for the 1st chamber 501 concerned It is the thing by which the source of the parallel plate mold plasma is used at least for the 2nd chamber 502 concerned and to set up like.
[0058] the amorphous fluoridation carbon film connected to the chamber 513 for conveyance in this example -- the 1st chamber 501 for membrane formation -- at least -- the 2nd chamber 502 -- a plasma consistency -- 5x109 unit/cm3 it is -- it consists of membrane formation equipment of a parallel plate mold, and the manufacturing installation of the semiconductor device of the multi chamber method into which the vacuum system is divided with interlocking [514] is shown.
[0059] That is, in this example, the description is that the plasma consistency of the 2nd chamber 502 used for the silicon oxide formed after membrane formation of an amorphous fluoridation carbon film makes it lower than that of the 1st chamber 501 used for membrane formation of an amorphous fluoridation carbon film. Here, the relation of the plasma consistency and substrate temperature when not performing substrate cooling at the time of silicon oxide membrane formation to drawing 7 is shown.
[0060] It is a plasma consistency 2x1010 unit/cm3 Even when lifting of the sample temperature in a membrane formation process does not perform substrate cooling by making it below, it can control at 400 or less degrees. Therefore, since the temperature of a wafer periphery part did not rise at 400 degrees C or more and disassembly of an amorphous fluoridation carbon film was not produced, film peeling has been prevented. In addition, although the multi chamber method is used by this

example, it cannot be overemphasized that it can apply even if it is equipment with the 1st chamber which forms an amorphous fluoridation carbon film and the 2nd chamber which forms silicon oxide separate [that the silicon oxide deposited on the upper part of an amorphous fluoridation carbon film or the temperature rise at the time of silicon nitride deposition should just be suppressed].

[0061] The same semiconductor device as the conventional example which used the carbon film for some multilayer interconnections and which is shown in drawing 8 was created using these equipments. Since an amorphous fluoridation carbon film did not accumulate on the wafer edge, there is no film peeling by wafer edge temperature rising at the time of the silicon oxide membrane formation after amorphous fluoridation carbon film membrane formation, and the semiconductor device was able to be formed. It was able to become possible to decrease the number of particle in the equipment which this had produced conventionally, the wafer processing number of sheets per unit time amount was able to be raised, and the yield was able to be raised further.

[0062] Next, it attaches and explains to the 2nd example of the manufacture approach of the semiconductor device concerning this invention, referring to drawing 9 thru/or drawing 11 . That is, in the 1st example of the semiconductor device manufacture approach concerning above mentioned this invention, although this example shows the example which formed wiring using the etching approach, when forming the 1st wiring layer 802 using the CMP (Chemical Mechanical Polishing) approach, it is an example of the approach of not making it exposing, and making and manufacturing an amorphous fluoridation carbon film at the wafer edge, in this example.

[0063] the silicon oxide 804 top prepared on the substrate 803 as first shown in drawing 9 (A) -- C four F8 etc. -- carbon fluoride gas is used as a raw material, and the carbon film 801 which has about 500nm thickness with plasma chemistry vapor growth (CVD) is made to deposit In the starting process, when shown in the above-mentioned example, it is the thing by which a carbon film 801 is not formed in the periphery section of the wafer concerned using the ring member concerned and which processes like similarly.

[0064] Then, the silicon oxide 804 which has about 1-micron thickness by the plasma CVD same on a carbon film 801 is made to deposit, as shown in drawing 9 (B). Then, as shown in drawing 9 (C), silicon oxide 804 is thin-film-ized in thickness of about 100nm by CMP. In this process, the oxide-film polish rate in a wafer edge field becomes quick depending on the polishing pressure force. Here, if polish clearance of the oxide film is carried out at the wafer edge, peeling will arise in an interlayer film.

[0065] In addition, a carbon film 801 shows the relation of the interlayer film peeling width of face and the CMP conditions in the wafer edge at the time of growing up all over a wafer to drawing 11 based on the result of an experiment. Like, if it has the polishing pressure force at the time of CMP with 3psi extent and is, the thing which is understood from drawing 11 and whose interlayer film peeling field width of face of the wafer circumference is 25mm will be understood.

[0066] Here, by covering the part of 30mm width of face of wafer rim circumferences using the ring-like member of this invention, when a carbon film 801 is made to be formed, the quick part, i.e., the wafer rim periphery, of an oxide film etching rate, the CMP processing in which the interlayer film which had become a problem conventionally does not separate is realizable. Then, as shown in drawing 10 (A), after applying a resist 808 to the semiconductor device shown in drawing 9 (C), a circuit pattern is formed in an interlayer film using a usual lithography technique and a usual etching technique.

[0067] Then, as shown in drawing 10 (B), the barrier metal 809 using TiN is formed so that thickness may be set to about 20nm, and the 1st-layer wiring metal 802 which consists of copper of about 1 micron of thickness continuously is formed. Then, as shown in drawing 10 (C), the barrier metal 809 using the 1st-layer wiring metal 802 and TiN concerned which consist of copper using the CMP approach is ground and embedded, and the 1st wiring layer of a mold is formed.
[0068] By repeating the process of drawing 10 (C) from drawing 9 (A) explained above, the multilayer-interconnection structure using the copper which has a carbon film 801 is realizable. Moreover, in still more nearly another example concerning this invention, the amorphous fluoridation carbon film was formed to the wafer edge, and even if it next used the plasma CVD of the low parallel plate mold of a plasma consistency for silicon oxide or silicon nitride deposition, the same effectiveness was acquired, without using a ring-like member.
[0069] That is, in the example concerned, are used in the production process of a semi-conductor. It is multi chamber equipment with which at least two chambers including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding the processed substrate concerned to the interior in order to form an insulator layer etc. in a processed substrate are prepared. The 1st chamber concerned is what is used for membrane formation of a carbon system interlayer film. The chamber of **** 2 While being used for membrane formation of silicon oxide or a silicon nitride and using the source of the parallel plate mold plasma for the 1st chamber concerned, it is the manufacturing installation of the semiconductor device with which the source of the parallel plate mold plasma is used also for the 2nd chamber concerned and which is constituted like.
[0070] As one example of the manufacture approach of the semiconductor device concerning this invention A chamber including the reactant gas supply means for supplying the electrode-holder section and the predetermined reactant gas holding a processed substrate to the interior so that more clearly than the above-mentioned explanation is used. It faces supplying reactant gas to this processed substrate to the processed substrate concerned in the approach of forming a carbon system interlayer film etc. at least, and forming a carbon system interlayer film etc. It is what makes it a basic method to perform membrane formation processing as the carbon system film concerned does not form membranes at the periphery edge of the processed substrate concerned. Moreover, the ring-like member which contacts the periphery edge of the processed substrate concerned currently held at the electrode-holder section concerned in the manufacture approach of the semi-conductor concerned is prepared. While making it function so that the ring-like member concerned may carry out the chuck of this processed substrate carried in the electrode-holder section concerned and performing membrane formation processing by this reactant gas to the processed substrate concerned in the ring-like member concerned, it is desirable to cover the surface periphery section of the processed substrate concerned to concentric circular.
[0071] Furthermore, while constituting the electrode-holder section concerned holding the processed substrate concerned from an electrostatic chuck in this example, it connects with the periphery edge of the electrostatic chuck concerned. It is also possible to constitute so that another electrode may be prepared and bias voltage may be impressed to the another electrode concerned. Furthermore, as another example In the thin film formation approach for forming the semiconductor device which has a carbon system interlayer film, silicon oxide, or a silicon nitride at least as an interlayer insulation film You may constitute so that the field on which a processed silicon substrate is made to deposit a carbon system insulator layer may become smaller than the field on which silicon oxide or a silicon nitride is made to

deposit.
[0072] Moreover, in the thin film formation approach for forming the semiconductor device which has a carbon system interlayer film, silicon oxide, or a silicon nitride at least as an interlayer insulation film as the thin film formation approach of the semiconductor concerning this invention, it is also possible to constitute so that membranes may be formed using what has the plasma consistency of the source of the plasma for depositing silicon oxide or a silicon nitride on a processed silicon substrate lower than the source of the plasma which deposits a carbon system interlayer film.
[0073]
[Effect of the Invention] The coat piece in the wafer periphery resulting from disassembly of an amorphous fluoridation carbon film seems not to separate, if this invention is equipment constituted so that a boundary region may not be provided with an equipment configuration by which an amorphous fluoridation carbon film is not formed in amorphous fluoridation carbon film membrane formation equipment and the temperature at the time of membrane formation might not exceed the thermal resistance of an amorphous fluoridation carbon film and this invention concerned is used as stated above.
[0074] A processed substrate is especially installed in the substrate installation base of the processing interior of a room at least at the membrane formation equipment of a carbon system interlayer film. The member of the shape of a ring with the bore of a ring-like member smaller than the diameter of said electrostatic chuck is used. The circumference of processed substrate surface A bonnet, It is the membrane formation processor which the constant width with the part of the periphery of a substrate is not formed, but limits the membrane formation range, or the constant width with the part of the border of a substrate is membrane formation equipment which is made not to be formed by changing substrate temperature and bias impression with a center section.
[0075] Or in this invention, it is the manufacturing installation of the semiconductor device which consists of plasma membrane formation equipment of the parallel plate mold with which membrane formation substrate temperature does not rise for membrane formation of the silicon oxide which forms membranes on a carbon system interlayer film, or a silicon nitride. Therefore, in the silicon oxide or silicon nitride formation formed on an amorphous fluoridation carbon film, it abolishes that a field which exceeds the thermal resistance of an amorphous fluoridation carbon film exists in a wafer side, and disassembly of an amorphous fluoridation carbon film does not occur.
[0076] Peeling of the oxide film by CF system etching gas which occurs in disassembly of an amorphous fluoridation carbon film is also controlled, and a coat seems consequently, not to separate easily on a wafer periphery. Moreover, by using the semiconductor fabrication machines and equipment of this invention for multilayer-interconnection formation of a semiconductor device, it was able to become possible to decrease the number of particle in the equipment conventionally produced for periphery peeling, the wafer processing number of sheets per unit time amount was able to be raised, and the yield was able to be raised further.

[Translation done.]